SYUF 1: SYUF I

Zeit: Mittwoch 14:00–16:00 Raum: VMP 8 HS

Hauptvortrag SYUF 1.1 Mi 14:00 VMP 8 HS

Atoms and molecules in intense FEL radiation — •Artem Rudenko — Max Planck Advanced Study Group at CFEL, Nottkestrasse 85 22607 Hamburg

The emission of few electrons from atoms, molecules, clusters or solids constitutes one of the most fundamental processes occurring when intense VUV or X-ray radiation interacts with matter, underlying essentially all practical applications of free-electron lasers. Recent development of the Free electron LASer in Hamburg (FLASH) along with the progress in high-harmonics generation made multi-photon multi-electron transitions in this energy range experimentally accessible, triggering enormous theoretical interest and opening the way for a variety of time-resolved imaging schemes. Here an overview of recent experimental studies on few-photon-induced fragmentation of rare gas atoms and simple diatomic molecules performed at FLASH employing coincident cold-target recoil ion and electron momentum spectroscopy will be presented. Particular examples include a disentanglement of sequential and direct ('non-sequential') mechanisms for few-photon double ionization of Ne and He atoms, identification of different dissociation and Coulomb explosion pathways in FEL-induced fragmentation of N2, O2, D2 molecules, and the results of the first VUV-VUV pump-probe experiments. The latter measurements not only allow for a time-resolved mapping of fragmenting molecular states, but also yield valuable information on the properties of the FEL pulse via channel-selective analyses of autocorrelation-like patterns.

Hauptvortrag SYUF 1.2 Mi 14:30 VMP 8 HS

Electronic decay in clusters and molecules subject to intense FEL radiation — •Vitali Averbukh, Ulf Saalmann, and Jan Michael Rost — Max Plank Institute for the Physics of Complex Systems, Dresden, Germany

Electronic decay sets in after ionization or excitation of an inner-shell electron by absorption of a high-energy photon, and can proceed by a wide variety of physical mechanisms leading to emission of secondary electrons on femto- or attosecond time scales. A distinctive feature of the interaction of molecules and clusters with intense FEL pulses is the capability of the FEL to promote the target system into a highly ionized state well within the pulse duration. Practically, this means that the electronic decay processes induced by the FEL radiation occur in a highly charged environment. In this presentation, I will review our recent theoretical work on the effect of the charged environment on the intra- and inter-atomic decay processes in clusters and molecules. It will be shown that the presence of a neighboring charge can affect the decay rates, sometimes daramatically, through the distortion of atomic orbitals involved in the non-radiative electronic transitions. Moreover, it will be argued that for the processes leading to emission of relatively slow secondary electrons, the mere concept of the exponential decay characterized by a rate may no longer be applicable because of the trapping of the emitted electrons by the neighboring charges.

Hauptvortrag SYUF 1.3 Mi 15:00 VMP 8 HS

Spectroscopy of Highly Charged Ions with Free Electron Lasers — •Sascha Epp[1], Martin Simon[2], Thomas Baumann[2], Günter Brenner[2], Volkhard Mäckel[2], Paul Mokler[2], Hiro Tawara[2], Natalia Guerassimova[3], Evgeny Schneidmiller[3], Rolf Treusch[3], José Crespo Lopéz Urrutia[2], and Joachim Ullrich[2] — [1]Max Planck Advanced Study Group at CFEL, 22603 Hamburg, Germany — [2]Max-Planck-Institute für Kernphysik, 69117 Heidelberg, Germany — [3]DESY, 22603 Hamburg, Germany

Resonant laser spectroscopy of soft x-ray transitions in highly charged ions (HCIs) by means of Free Electron Lasers (FELs) has been proven to be a promising technique with the potential for unprecedented precision on energetic transitions unreachable by traditional laser spectroscopy. The technique relies on combining a state-of-the-art EBIT with a FEL (like FLASH), measuring the resonant fluorescence yield by the trapped HCIs after their excitation as a function of the wavelength of the FLASH-light. Three fundamental transitions at energies E_0 were investigated, namely $1s^2 2s\ ^2S_{1/2}$–$1s^2 2p\ ^2P_{1/2}$ in Li-like Fe^{23+} at 48.6 eV, Li-like Cu^{27+} at 55.2 eV, and $1s^2 2s\ ^2S_{1/2}$–$1s^2 2p\ ^2P_{3/2}$ in Fe^{23+} at 65.3 eV. The latter demonstrates resonant laser spectroscopy of multiply or highly charged ions at more than one order of magnitude higher transition energies as reported elsewhere. We attain presently a resolution of $E_0/\mathrm{FWHM} = 2500$ for the individual spectral lines, resulting in a relative precisions of 8 parts-per-million (ppm) for the determination of the center-of-mass wavelength per hour of beamtime.

Hauptvortrag SYUF 1.4 Mi 15:30 VMP 8 HS

Ultra-fast dynamics in atoms and solids — •Alexander Föhlisch — Institut für Experimentalphysik, Universität Hamburg, Germany

In materials science and femtochemistry, the frontier of knowledge spans from molecular surface dynamics for heterogeneous catalysis with little explored transition states to functional materials with often surprising properties and phase transitions as well as to chemical dynamics in solution. In these systems the interplay between local properties and nanoscale phenomena govern their physics and chemistry - and femtosecond soft X-ray pulses are ideal probes of their dynamics. FLASH has allowed us to take a great step into femtosecond time resolved X-ray methods based on innovative instrumentation for femtosecond time resolved soft X-ray spectroscopy and resonant X-ray scattering methods. In this talk the new physics we can access is explored through our research of femtosecond time resolved photoemission as well as resonant inelastic and elastic X-ray scattering for materials science at FLASH.